

WHAT IS CLAIMED IS:

1. A device for performing statistical re-multiplexing of digital video signals, the device comprising:
- a scheduler having first and second data inputs, a data output, and first and second control ports, the scheduler for combining signals at the plurality of data inputs into a signal at the data output that matches channel bandwidth of a transport medium coupled to the output of the scheduler;
- a first de-multiplexer having a data input, a control port and a data output, the first de-multiplexer re-coding an input signal in response to a first control signal received at the control port, the data input of the first de-multiplexer coupled to receive a first channel of data, the control port of the first de-multiplexer coupled to the first control port of the scheduler, the data output of the first de-multiplexer coupled to the first data input of the scheduler; and
- a second de-multiplexer having a data input, a control port and a data output, the second de-multiplexer re-coding an input signal in response to a second control signal received at the control port, the data input of the second de-multiplexer coupled to receive a second channel of data, the control port of the second de-multiplexer coupled to the second control port of the scheduler, the data output of the second de-multiplexer coupled to the second data input of the scheduler.
2. The device of claim 1 further comprising an encoder having a data input, a data output, and a control port, the encoder for performing compression and rate adjustment on a data

3 stream, the data input of the encoder coupled to receive a non-compressed stream of video
4 sequences, the output of the encoder coupled to the input of the first de-multiplexer.

1 3. The device of claim 1 further comprising a splitter having a data input, first and
2 second data output, the splitter converting a single stream into a plurality of streams of data, the
3 input of the splitter coupled to receive a stream of compressed data having a plurality of
4 channels, the first output of the splitter coupled to the data input of the first de-multiplexer, and
5 the second output of the splitter coupled to the data input of the second de-multiplexer.

2 4. The device of claim 1 further comprising n additional de-multiplexers, each of the
3 n additional de-multiplexers having a data input, a control port and a data output, each of the n
4 additional de-multiplexers re-coding an input signal in response to a signal received at the
5 respective control port, and wherein the scheduler has a corresponding data input and control port
6 for each of the n additional de-multiplexers, the data input of each of the n additional de-
7 multiplexers coupled to a respective corresponding data input of the scheduler, the control port of
8 each of the n additional de-multiplexers coupled to a respective corresponding control port of the
scheduler.

1 5. The device of claim 1, wherein the scheduler further comprises:
2 a scheduling table having a first input and a first output for generating control signals to
3 select a particular channel for output based on an input control signal, the first
4 input coupled to the first and second de-multiplexer; and
5 a multiplexer having a plurality of data inputs, a data output, and a control input for
6 providing at the data output of the multiplexer one of signals received at the

7 plurality of data inputs, the control input of the multiplexer coupled to the output
8 of the scheduling table, each of the plurality of data inputs coupled to the
9 respective data outputs of the first and second de-multiplexer.

1 6. The device of claim 5, wherein the scheduling table is a plurality of fixed sized
2 tables that can be alternatively accessed.

1 7. The device of claim 5, wherein the scheduler further comprises:
2 a controller for controlling a rate at which the scheduler outputs data and which channels
3 are output, the controller having a first set of control ports, a first control port and
4 a second control output, at least one port in the first set of control ports coupled to
5 the control input of the first de-multiplexer and the control input of the second de-
6 multiplexer, and the first control output coupled to the first input of the scheduling
7 table;
8 a first buffer having a data input, a data output, and a control input, for storing data on a
9 first in, first out basis, the data input of the first buffer coupled to the data output
10 of the first de-multiplexer, the data output of the first buffer coupled to a first of
11 the plurality of data inputs of the multiplexer, and the control input coupled to the
12 second control output of the controller; and
13 a second buffer having a data input, a data output, and a control input, for storing data on
14 a first in, first out basis, the data input of the second buffer coupled to the data
15 output of the second de-multiplexer, the data output of the second buffer coupled
16 to a second of the plurality of data inputs of the multiplexer, and the control input
17 coupled to the second control output of the controller.

1 8. The device of claim 5, wherein the scheduler further comprises:
2 a filler packet inserter having an input and an output for providing filler packet data in
3 response to a control signal on the input, the input of the filler packet inserter
4 coupled to a second control output of the scheduling table; and
5 an output buffer having a first input, a second input and an output, for storing data, the
6 first input of the output buffer coupled to the output of the multiplexer and the
7 second input of the output buffer coupled to the output of the filler packet inserter.

8 9. The device of claim 8, wherein the filler packet inserter inserts a packet that
9 contains a user-defined program identification number (PID) as the filler packet.

10 10. The device of claim 5, wherein the controller receives and analyzes data from the
11 first and second de-multiplexers for a sliding window of time T , and then sends out number of
12 bits corresponding to a time T_1 for each of the channels, where T_1 is less than or equal to T .

13 11. A method for processing video data, the method including the steps of:
14 performing bit stream analysis;
15 determining an incoming bit rate for each channel;
16 determining whether the combined bandwidth requirement of all the channels exceeds the
17 channel capacity;
18 performing rate adjustment by re-multiplexing the channels if the combined bandwidth
19 requirement of all the channels does not equal the channel capacity;
20 scheduling the channels for transmission; and
21 combining the channels and transmitting the combined channels over the transport

medium.

12. The device of claim 11, wherein the step of performing bit stream analysis is performed for a sliding window of time having duration T , and wherein the step of combining the channels and transmitting the combined channels is for a time T_1 for each of the channels, where time T_1 is less than or equal to T .

13. The device of claim 11, wherein the step of performing rate adjustment includes inserting extra packets, and the step of combining and transmitting includes adding and transmitting the inserted extra packets.

14. The device of claim 13, wherein the extra packets include user specified useful packets that contain user defined program identification (PID) information.

15. The device of claim 11, wherein the step of performing rate adjustment includes a) re-encoding a selected channel, b) removing stuffing bytes, and c) removing user-defined unuseful packets, and the step of combining and transmitting includes combining and transmitting the re-encoded channel.

16. A method for processing video data, the method including the steps of:
examining a plurality of channels of bit streams each having a bit rate;
determining whether a sum of the bits rates for the plurality of channels is equal to a channel capacity;
if the sum of the bits rates for the plurality of channels is equal to a channel capacity, scheduling data for the plurality of channels for transmission; and transmitting

7 data for the plurality of channels.

1 17. The method for processing video data of claim 16, further comprising the steps of
2 determining whether the sum of the bits rates for the plurality of channels is greater than
3 the channel capacity;
4 if the sum of the bits rates for the plurality of channels is greater than the channel
5 capacity then performing the steps of:
6 selecting a channel;
7 determining whether the selected channel has a bit rate greater than the minimum
8 bit rate for the channel; and
9 reducing the bit rate for the channel if it is determined that the selected channel
10 has a bit rate greater than the minimum bit rate for the channel.

1 18. The method for processing video data of claim 17, further comprising the steps of:
2 determining whether there is another channels having a bit rate greater than its minimum;
3 and
4 performing rate conversion if there are no channels having a bit rate greater than its
5 minimum.

1 19. The method for processing video data of claim 16, further comprising the steps of
2 determining whether the sum of the bits rates for the plurality of channels is less than the
3 channel capacity;
4 if the sum of the bits rates for the plurality of channels is less than the channel capacity
5 then performing the steps of:

6 selecting a channel;
7 determining whether the selected channel has a bit rate is close to the minimum
8 bit rate for the channel; and
9 increasing the bit rate for the channel if it is determined that the selected channel
10 has a bit rate close to the minimum bit rate for the channel.

1 20. The method for processing video data of claim 19, further comprising the steps of:
2 determining whether there is another channels having a bit rate less than its maximum;
3 and
4 adding null packets to the transmission if there are no channels having a bit rate less than
5 its maximum.

1 21. The method for processing video data of claim 20, wherein the step of adding
2 extra packets, instead of adding the null packet, adds packets having useful data that the include
3 user defined program identification information (PID) for the purpose of sending opportunistic
4 data.

1 22. The method for processing video data of claim 16, wherein at least one of the
2 plurality of channels of bit streams is a data stream that is buffered and not recoded.

1 23. The method for processing video data of claim 18, wherein the step of reducing
2 the bit rate for the channel includes the steps of dropping a B-frame and replacing it with a new
3 B-frame which only repeats the previous frame.

1 24. The method for processing video data of claim 16, wherein the step of scheduling

$$4 \quad \text{PacketPerTable (I)} = (\text{ScheduleTableSize} * \text{Rate(i)}) / (\text{TotalBandwidth}).$$
[illegible]